

Declaration of Differences
In Relation to: Hunt, Jr. et al. (U.S. Patent No. 5,221,377)
Wm. Troy Tack, Serial Number 09/681,076

In the final office action (serial number 09/681,076), the Patent Examiner rejected all claims under 35 U.S.C. 103(a) as being unpatentable over Hunt, Jr. et al. (U.S. Patent No. 5,221,377) for the following reasons:

- 1) Hunt, Jr. et al. has composition ranges similar to that of the Applicants
- 2) Hunt, Jr. et al. teaches an alloy with a yield strength of greater than 84 ksi in claims and shows alloys with a yield strength greater than 90 ksi
- 3) Hunt, Jr. et al. teaches solution heat treatment, quenching and artificial aging steps

It was noted by the Patent Examiner that Hunt, Jr. et al. does not teach using the alloy to create lightweight alloy stock for manufacturing gun frames and gun components.

In response to this final office action, the applicants reviewed the Hunt, Jr. et al. patent and discovered the following:

- Hunt, Jr. et al. clearly emphasize plate and extruded product forms for use in aerospace structures
- Yield strength values of 85-86 ksi are stated for plate products in the L-orientation and 89-90 ksi for extruded products in the L-orientation

With regard to forgings, Hunt, Jr. et al. utilize "Table 5" (note: Table 5 contains strength properties for alloy 7050 forgings) within their patent as a basis for the following claims:

- Claim 125: A forging with a yield strength value 5% higher than the values in Table 5
- Claim 126: A forging with a yield strength value 7% higher than the values in Table 5
- Claim 127: A forging with a yield strength value 10% higher than the values in Table 5
- Claim 128: A forging with a yield strength value 12% higher than the values in Table 5
- Claim 129: A forging with a yield strength value 15% higher than the values in Table 5

With regard to forgings, claim 129 anticipates the highest yield strength values. Specifically, claim 129 anticipates a yield strength 15% higher yield strength values in Table 5. Upon close examination of Table 5, the range of yield strength values stated range from 50-63 ksi. Applying claim 129 to these yield strength values results in the following:

- Claim 129, yield strength 15% higher than Table 5 values
- Multiply Table 5 yield strength values (50 to 63 ksi) by 1.15

- 50 ksi x 1.15 = 57.5 ksi
- 63 ksi x 1.15 = 72.5 ksi

Specific to forgings, a yield strength value of **72.5 ksi** is the highest possible strength value anticipated by Hunt, Jr. et al. The Applicants respectfully submit that the yield strength values afforded by the processing steps contained in the claims of the present application cite a yield strength value of at least **80 ksi** in the dependent claims and **90 ksi** in the independent claims. Accordingly, many of the arguments submitted by the applicants with regard to the Miyasato patent (first office action) apply to Hunt, Jr. et al. For the record, the Applicants repeat these arguments with the emphasis on Hunt, Jr. et al.

Objection under 35 U.S.C. 103(a) as being unpatentable over Hunt, Jr. et al. in view of 2002 Bushmaster arms catalog.

The Applicants respectfully request reconsideration and withdrawal of this objection for the following reasons:

Hunt, Jr. et al. clearly teaches a process for producing aluminum alloy structural members for aircraft and teaches many processing steps that are similar to that of the present invention. He also states a specific yield strength value of at least **72.5 ksi** in the specification and selected claims.

Bushmasters Firearms catalog 2002 teaches the use of aircraft quality 7075 in a T6 temper for its gun receivers. Bushmaster also teaches that the gun receivers may be forged. The T6 temper inherently includes the steps of solution heat treatment, quenching and artificial aging.

The Patent Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the aluminum alloy of Hunt, Jr. et al. to manufacture firearms parts as taught by Bushmaster.

The combination of the Hunt, Jr. et al. teaching to manufacture firearms parts as taught by Bushmaster would be an inoperable combination. The Hunt, Jr. et al. alloy, as used by Bushmaster would not achieve the strength required to produce the current invention.

The Applicants respectfully submit that alloy formulations with a yield strength value of at least 72.5 ksi have been prominently used as gun frames and gun components for many years. Alloy 7075, utilized by Bushmaster Firearms, is also widely used by other gun manufacturers. Significantly, alloy 7075 does have a yield strength value of at least 72.5 ksi, for example, the Aluminum Handbook states a yield strength value of 73 ksi for alloy 7075. The Applicants discuss alloy 7075 in some detail in the specification of the patent and its prominent use in pistol frames and low caliber revolvers.

In the case of heavy caliber handguns, the Applicants stated the following in the specification:

"Often, the 7075 frames break after just a few test firings, thereby excluding this material as a candidate for heavy caliber revolvers. In contrast, the gun frame comprised of the lightweight alloy stock of this invention withstood extensive test firings. Specifically, a .357 Magnum was mounted in a gun vise and subjected to 3000 rounds using an ultra-high caliber 158-grain .357 load. Even though this test is the equivalent of 9000 hand-fired rounds, the gun held up to this extensive number of firing cycles. Previously, only steel and titanium alloys have withstood such rigorous testing. It is significant that the starting stock of this invention can withstand the repeated firing loads since the gun frame is just one-third the weight of steel handgun frames and 70% lighter than titanium alloy frames."

Lack of Implementation of Prior Art, Current Invention Teaches a Solution of a Long-Felt and Unsolved Need.

Hunt, Jr. et al., as stated by the Patent Examiner, did not anticipate that their invention for aircrafts structural members would be applicable to a gun frame or gun component. The patent assignee of the Hunt, Jr. et al. patent, the Aluminum Company of America, has sold aluminum alloys to gun manufactures for nearly 50 years. Alloy 7075 is the leading alloy that is now provided into this industry. If one skilled in the art were to take the alloy of Hunt, Jr. et al., and attain a yield strength of at 72.5 ksi, the use of this material in a heavy caliber handgun frame would result in failure after just a few rounds of firing. Widely used alloy 7075, which has a higher yield strength value (73 ksi) than that proposed by Hunt, Jr. et al., has historically failed in firing trials within a few rounds. In contrast, the current invention provides a material that can last for >9000 hand fired rounds. With regard to the relatively smaller caliber handguns, the present invention allows for downsizing to smaller dimensions that cannot be achieved with alloy 7075.

Multiplicity of Steps

The Applicants also submit that the multiplicity of steps required in the present invention have not been previously stated in the prior art. Hunt, Jr. et al. state similar processing steps in their specification. Nevertheless, we do not recognize an instance whereby the sequence proposed in the present invention is specifically stated by the teaching of Hunt, Jr. et al. This is particularly evident in the fact that the Applicants proposed claims are relevant only to gun frames and gun components and only at yield strength values greater than 80 ksi.

Commercial Success and Professional Recognition of Present Invention.

The Applicants invention is now commercially used by Smith & Wesson as the frame material in several revolver models. A feature article states the following:

"Of course the aluminum frame/titanium cylinder design of the S&W Air-Lite Ti or the Taurus MultiAlloy offerings do have limitations – most obviously, no magnum chamberings. Titanium cylinders can be made more than strong enough to handle loads up to and including .357 Magnum, .41 Magnum and .44 Magnum, but typical firearms-grade aluminum alloy frames absolutely cannot – which is why there have never been any Airweight type aluminum frame/steel cylinder magnum revolvers in the first place." (Shooting Times, October 2000, pp 42-45).

Smith & Wesson is clearly one of the premier gun manufacturers in the world and was the pioneer in handgun development starting in 1852. Smith & Wesson also employed aluminum alloys in handguns as early as 1952. Since that time, however, alloy 7075 has been the state-of-the-art in handgun frames. Nevertheless, the fact that alloy 7075 handgun frames will fracture when heavy caliber rounds are utilized has eliminated the consideration of this alloy for the heavy caliber handguns. Accordingly, gun designers at Smith & Wesson have never been able to lightweight their heavy caliber handguns.

Unexpected Results for the Present Invention

The Applicants have provided the current invention to Smith & Wesson, and the invention has led to performance levels that were previously unattainable in their product engineering history. Smith & Wesson currently markets this innovation as their "AirLite Sc" models, and the product has attained commercial success. As stated in the current invention, *a lightweight alloy is now being used for the first time in heavy caliber handguns*. The method to produce lightweight gun frames and gun components is also employed to produce handgun cylinders, an unprecedented use of a lightweight alloy. Smith & Wesson also used the principles of this invention to redesign the gun frames of the smaller caliber handguns that were previously comprised of 7075. In this instance, the gun frames are smaller, thereby taking advantage of the higher strength afforded by this invention.

The Applicants submit that two significant results in the current patent application are unexpected results. First, while the increased strength was remarkable, the method to produce the starting stock for the gun frame would not previously be expected to withstand the repeated firing loads, an accomplishment that has heretofore been achieved only through the use of steel or titanium alloys. The fact that the current invention was utilized in a heavy caliber handgun that survived 9000 rounds of firing was a surprising result to the engineering staff at Smith & Wesson. Second, the fact that higher strength was attained would not guarantee the effectiveness of this invention to be utilized as the material of construction for the gun cylinder. In this environment, the high temperature and high velocity of the bullet discharge gases cause erosion of the interior of the cylinder when aluminum alloys are employed. Again, this application was previously the domain of steel and titanium alloys. By contrast, the current invention is already successfully employed as a gun cylinder in many Smith & Wesson models.

To underscore the importance of the different uses of the present invention, the Applicants submit that commercialization of this invention is in the early stages whereby designers are now recognizing the previously unappreciated advantage of employing this process in the production of many different gun frames and gun components. For example, the Bushmaster example stated by the Patent Examiner currently utilizes alloy 7075. If Bushmaster seeks to reduce the size of this component, they will reach a point where the 7075 cannot withstand the forces that are applied during operation. At that point, the present invention can be utilized, thereby enabling Bushmaster to achieve new performance levels.

Differentiation of Current Application with Hunt, Jr. et al.

In Hunt, Jr. et al., the highest anticipated yield strength value for a forging is 72.5 ksi. The present invention claims a yield strength value of greater than 80 ksi in the broadest claims and greater than 90 ksi in the dependent claims. The initial claim of the present application contains the following:

- 1) A method for producing a lightweight starting stock for gun frames and gun components comprising the following sequence:
 - a) mixing alloying elements into aluminum with the alloy composition containing 6.2 to 9.0 wt% Zn, 1.0 to 3.0 wt% Mg, 0 to 2.5 wt% Cu and 0.02 to 0.50 wt% of at least one grain refining element selected from a group consisting of Zr, Sc, Cr, Mn, Ti and Hf and casting said elements to provide a billet,
 - b) extruding said billet to provide starting stock,
 - c) forging said starting stock to provide a gun frame or gun component,
 - d) solution heat treating said gun frame or gun component to provide a solution heat treated gun frame or gun component,
 - e) quenching said gun frame or gun component to provide a quenched gun frame or gun component
 - f) artificial aging said gun frame or gun component to provide and artificially aged gun frame or gun component wherein said gun frame or gun component has a yield strength value of at least 80 ksi.

While Hunt, Jr. et al. cite similar composition ranges and similar processing steps, there is not an instance whereby the alloy is subjected to the sequential steps cited in the current application. The present invention resulted in unexpected results in gun firing tests that are in part attributed to the fact that yield strength values of 90 ksi were attained in a forged component. In viewing the sequential steps from claim 1, the Applicants note that the extrusion of the alloy in step (b) converts the grain structure from an "as-cast" structure to a somewhat elongated structure typical of an extrusion. This grain structure is further refined in the forging step. Combining each of these working steps serves to develop a grain structure that consists of a mixture of high angle and low angle grain boundaries or substructure. The highly developed substructure provides higher strength by virtue of the well-known Hall-Petch relationship whereby strength increases as grain

size decreases. Subsequent to casting, extruding and forging, the step of solution heat treatment and quenching places most of the alloying elements into a meta-stable, supersaturated solid solution. As the artificial aging step is applied, the diffusion of alloying elements progresses and non-equilibrium strengthening precipitates are formed. The substructure developed during the extrusion and forging steps fosters favorable diffusion paths and results in a high population of fine strengthening precipitates. Accordingly, the sequential steps provided in the present invention provide unprecedented properties in the alloy and in performance testing in actual handguns. Hunt, Jr. et al. did not cite these specific steps in this order and consequently could not achieve strength properties that would enable the enhanced performance in a handgun.